EPIDEMIOLOGY OF VIRAL HEPATITIS B IN THE TROPICS*

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NUMEROUS studies have confirmed the original reports of Blumberg et al.[1] that the prevalence of hepatitis B is high in the normal adult population in many countries in the tropics and subtropics, as compared with those in the temperate zones. Most of these studies have been carried out on specified cohorts, such as hospital patients, soldiers, schoolchildren, or blood donors.

The prevalence rates of hepatitis B antigen (HB Ag) in 715 children in Ibadan less than five years of age and in 29,911 adult volunteer blood donors were 4.2% and 6.04%, respectively. Further breakdown of these figures into age subunits is as shown in Tables I and II. In a group of 433 school children four to 20 years of age the prevalence rate was 6.7%.[2] These data show that hepatitis B antigenemia is found at a relatively low frequency under the age of two years; after this the frequency rises to adult levels. In the schoolchildren and adult blood donors there was no correlation between antigenemia and hemoglobin genotype or ABO group. However, when the schoolgirls were considered alone, there was a statisically significant association between blood group A and hepatitis B antigenemia.[2]

Our finding that a high prevalence rate of hepatitis B antigenemia develops after the age of two years is similar to the finding of Bagshawe and Nganda,[3] but different from that of Szmuzness et al.,[4] who found a prevalence of 11.7% in infants less than one year old.

Various hypotheses have been put forward to explain the differences in prevalence rates of HB Ag between tropical or subtropical countries and temperate countries. Blumberg et al.[5,6] suggested that the tendency to develop the carrier state of HB Ag may be inherited

*Presented as part of *A Day on the Liver* held by the New York Academy of Medicine and the International Association for the Study of the Liver at the Academy, March 7, 1974.

TABLE I. HEPATITIS B ANTIGEN IN IBADAN: DISTRIBUTION BY AGE AND SEX IN 715 CHILDREN LESS THAN FIVE YEARS OF AGE

Age group (years)	*Males*			*Females*			*Total*		
	No. tested	*Positive*		*No. tested*	*Positive*		*No. tested*	*Positive*	
		No.	*%*		*No.*	*%*		*No.*	*%*
Less than 1	114	2	1.7	100	1	1.0	214	3	1.4
1 to 2	100	2	2.0	121	3	2.4	221	5	2.3
2 to 3	75	5	6.6	60	4	6.6	135	9	6.6
3 to 4	40	4	7.5	50	4	8.0	90	8	8.8
4 to 5	25	2	8.0	30	3	10.0	55	5	9.0
Total	354	15	4.2	361	15	4.2	715	30	4.2

TABLE II. AGE DISTRIBUTION OF 1,809 BLOOD DONORS POSITIVE FOR HEPATITIS B ANTIGEN (HB AG) IN IBADAN. FEBRUARY 1971 TO JANUARY 1974

Age (years)	15-20	21-25	26-30	31-35	36-40	41-45	46-50	More than 50	Unspecified ages
Positive for HB Ag (No.)	383	599	389	186	129	46	44	8	25

Total number of donors	29,911
Total number of donors positive for HB Ag	1,809
Prevalence rate of HB Ag	6.04%

as an autosomal recessive trait. This gene is considered to be rare in populations of temperate countries but common in those of tropical countries.

Although the clustering of carriers has been noted in our earlier study,[7] factors other than those due to a common environment have yet to be completely excluded. The finding in patients with thalassemia of a genetic factor, Gm type, which appears to determine the persistence or disappearance of HB Ag, [8, 9] calls for similar investigations in our environment.

Prince[10] suggested that bloodsucking insects may play a significant role in the transmission of hepatitis B infection in tropical countries.

TABLE III. WILD-CAUGHT MOSQUITOES CONTAINING HEPATITIS B ANTIGEN. LOCATION, COLLECTION METHOD, SPECIES, POOL SIZE, AND DESCRIPTION

No.	*Location*	*Collection method*	*Species*	*Pool size and description*
1.	Ibadan	Spray sheet	*Culex pipiens fatigans*	14 engorged/gravid
2.	Ibadan	Spray sheet	*Culex pipiens fatigans**	14 engorged/gravid
3.	Ibadan	Spray sheet	*Culex pipiens fatigans*	15 fed
4.	Ibadan	Spray sheet	*Culex pipiens fatigans**	15 fed, 7 gravid
5.	Ikeja	Off horses	*Culex spp.*	8 fed and unfed
6.	Nupeko Forest	Light trap	*Mansonia africanus* and *uniformis*	21 unfed
7.	Nupeko Forest	Biting	*Mansonia africanus*	15 fed
8.	Nupeko Forest	Biting	*Mansonia africanus*	15 (5 fed)
9.	Nupeko Forest	Biting	*Mansonia africanus*	15 unfed
10.	Nupeko Forest	Biting	*Mansonia africanus*	15 unfed
11.	Nupeko Forest	Biting	*Mansonia africanus**	14 fed
12.	Nupeko Forest	Biting	*Mansonia africanus**	14 fed
13.	Nupeko Forest	Monkey-baited trap	*Mansonia africanus* and *uniformis*	22 fed
14.	Nupeko Forest	Monkey-baited trap	*Mansonia africanus*	4 fed
15.	Nupeko Forest	Biting	*Mansonia africanus*	17 unfed
16.	Nupeko Forest	Biting	*Anopheles coustani* and *paludis*	11 fed and unfed
17.	Nupeko Forest	Biting	*Anopheles paludis*	11 unfed
18.	Nupeko Forest	Light trap	*Anopheles coustani* and *paludis*	15 unfed

*Arborviruses simultaneously isolated from these. Two of 18 pools of mosquitoes which were positive for HB Ag contained Bwamba and Semiliki Forest viruses.

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This view was supported on epidemiological grounds by Blumberg.[1] Zebe et al. demonstrated that under certain conditions cockroaches could mechanically transmit HB Ag.[11] We demonstrated that under experimental conditions *Culex* mosquitoes infected with HB Ag could biologically transmit HB Ag by biting a suitable experimental animal.[12] Brotman et al.[13] suggested that transmission of HB Ag by mosquitoes was probably mechanical. However, they were able to detect HB Ag

TABLE IV. HEPATITIS B ANTIGEN (HB AG) AND ANTIBODY (HB AB) FOUND IN LOWER ANIMALS IN NIGERIA, 1970-1971

Animals	*No. tested*	*HB Ag pos.*	*HB Ag prevalence (%)*	*Location of HB Ag pos. animals*	*HB Ab pos.*	*HB Ag prevalence (%)*	*Location of HB Ag pos. animals*
Sheep	50	1	2.0	Sokoto	1	2.0	Ibadan
Cattle	126	1	0.9	Ibadan	6	4.8	Ibadan
Monkeys	41	1	2.3	Nupeko	0		
Goats	19	0			0		
Pigs	19	0			0		
Bats	10	0			0		
Baboons	3	0			0		
Camels	2	0			0		

pos. = positive.

by radioimmunoassay in 17% of engorged mosquitoes and in one of 18 pools of engorged bedbugs caught in the Ivory Coast—where the villagers showed a 6.5% prevalence rate for the antigen. Tin et al.,[14] in Burma, were able to confirm the results of our mosquito experiment. By the ordinary technique of immunoelectrophoresis we have detected HB Ag in 18 of 460 pools of mosquitoes caught in the wild (Table III). Bwamba and Semiliki arborviruses were isolated simultaneously in two of the pools which were positive for HB Ag. The possibility of the transovarian transmission of HB Ag has been raised by the finding of HB Ag in our unfed wild-caught mosquitoes.

Hb Ag and hepatitis B antibody (Hb Ab) have been detected in the sera of some lower animals collected from several towns in the northern states of Nigeria and Ibadan during 1970-1971. In sheep the prevalence rate was 2% for both HB Ag and HB Ab, for cattle it was 0.9% for HB Ag and 4.8% for HB Ab, and in monkeys it was 2.3% for Hb Ag (Table IV). In view of the close contact between man and domestic animals in these areas, another reservoir of infection would tend to increase the prevalence of this condition if a given common vector is involved.

Preliminary results of the subtypes of our HB Ag positive sera show that all the blood donors were awy (Table V). This subtype is classically associated with parenteral transmission.

TABLE V. SUBTYPES OF HEPATITIS B ANTIGEN IN IBADAN. PRELIMINARY RESULTS

Source	Subtype *awy*	*adw*
Blood donors	11	0
Sporadic hepatitis	3	1
Hepatocellular carcinoma	4	0

Other nonparenteral methods of transmission of HB Ag may involve social, cultural, economic, and other environmental factors. Olumide[15] studied the prevalence and certain epidemiological characteristics of HB Ag in 527 adult residents of Ibadan. The matched controls were drawn from the core area of Ibadan City and the higher class periphery of the town. The prevalence rate of HB Ag in each of these control areas was 12.6% by CFT. There was no significant association between the presence of the antigen and many of the factors examined, such as age, sex, marital status, education, income, religion, injection, dental treatment, blood tests, and medicinal, tribal, tattoo, or cosmetic markings. Unlike other diseases caused by unsanitary habits—such as ascariasis or ancylostomiasis— hepatitis B antigenemia showed no obvious social gradient. However, within each area certain trends were obvious. In the core area there were significant associations between hepatitis B antigenemia and frequent injections in the dispensary, repeated blood tests in the preceeding two years, and the method of sewage disposal. In the peripheral areas there were significant relations between hepatitis B antigenemia and the level of education, number of blood donations, and absence of protection from mosquitoes.

Heavy infestation with intestinal parasites, a condition common in the tropics, has been thought to favor the high prevalence of HB Ag in these areas.[16] Lewis et al.[17] have shown that in Ibadan there is no correlation between the presence of hookworm or *Strongyloides* and hepatitis B antigenemia.

Olumide[15] was unable to confirm the sexual transmission of HB Ag. In an ongoing study of HB Ag among patients at the University College Hospital (Ibadan Venereal Diseases' Clinic), only nine of

338 (2.7%) have so far been found to be carrying the HB Ag[18]—definitely less than the 6% prevalence rate found among our normal blood donors. The prevailing sociocultural taboo which demands abstinence from sex during menstruation might reduce the sexual transmission of HB Ag, since menstrual blood has recently been suggested as a vehicle for transmission of HB Ag.[19]

Other nonparenteral methods of transmission of HB Ag including feco-oral, aerosol, transplacental, and other routes still require investigation on a community-wide basis in tropical countries.

Conclusion

The data presented show that viral hepatitis type B occurs with high frequency in the tropics. The hazards of this huge reservoir of infection to the population at large, the social and economic implications of this disease, and the risks to the individual carrier of chronic liver disease—leading from chronic hepatitis, cirrhosis, to hepatocellular carcinoma—are major health problems, the gravity and effects of which cannot be calculated fully.

From the epidemiological data presented, a few preventive measures would seem logical. Eradication of vectors and improvement in the personal and environmental sanitation of communities are both indicated. Should the HB Ag prove protective, passive immunizations of selected groups may be advocated, especially if hepatitis B immune globulin can be produced cheaply. The development of an active vaccine against hepatitis B could be the biggest breakthrough in research on hepatitis. Because significant hepatitis B antigenemia is acquired after the age of two years, a vaccine capable of conferring active immunity to hepatitis B in childhood could become part of the immunization program in tropical and subtropical countries.

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